LXVI.—*On the Special Protection of Appendages in Process of Regeneration after Artificial Mutilation among Insects.*

By Edmond Bordage *.

When a limb is removed owing to self-mutilation from the body of an Arthropod, such as a crab or a Phasmid for instance, regeneration starts from the very surface of the section so produced. The same thing, however, rarely happens when, on the other hand, regeneration follows the artificial severance of a limb. Among Mantidæ, Blattidæ †, and the Orthoptera saltatoria, for example, artificial cuts are followed by contraction and by more or less marked displacement of the divided muscles, which are retracted within the chitinous covering of the limb, so that, if regeneration follow, the part in process of growth remains entirely hidden until the next moult. The chitinous case therefore in this instance plays the part of a protector.

It may even happen among the Mantidæ, which possess the power of self-mutilation developed in a high degree, or among the Blattidæ, where it is much less marked, that contraction of the muscles may be produced in the interior of the trochanter, or even inside the joint, if developed, that forms the haunch (*coxa*), after self-mutilation along the trochantero-femoral suture. In this case, if there be regeneration the part in process of growth will remain hidden until the next moult.

Most often, however, among the Mantidæ, and more rarely in the Blattidæ, this contraction does not take place after self-mutilation.

In this case one can very soon see whether there will be regeneration without its being necessary to wait for the next moult. It is true that one cannot perceive the various parts which make up the rudiment in process of growth, for it is coiled upon itself, and, what is more, covered over by the non-chitinized cuticle, which protects it after the manner of a pocket. This cuticle lacks transparency on account of its brownish coloration; but the very slightly marked projection which this protective pouch forms at the end of the trochanter shows nevertheless that the work of regeneration is going on.

In the Phasmidæ the rudiment in process of growth destined

* Translated from 'Comptes Rendus,' cxxix. (1899) pp. 501-504, by Wilfred Mark Webb, F.L.S. From a separate impression communicated by the Author.

† H. H. Brindley, 'On certain Characters of Reproduced Appendages in Arthropoda,' 1898.

to replace a limb detached by self-mutilation sometimes shows itself, but in an indistinct manner, coiled up under the protective cuticle, which has some degree of transparency in certain species.

So far as the Mantidæ and Blattidæ are concerned, I noticed that the amount of withdrawal of the muscles divided by self-mutilation within the chitinous covering was proportional to the violence of the efforts made by the insects in getting rid of the limb. When self-mutilation took place easily the contraction was practically *nil*.

It now remains for us to examine the particular case presented by the Phasmidæ.

When artificial separation takes place in the region comprising the femur and the upper two thirds of the tibia, contraction of the severed muscles is most marked. When, again, similar cuts are made in the upper part of the region formed by the lower third of the tibia, contraction is still produced, and as it is exactly there that the power of regeneration begins to show itself, the part in process of growth remains hidden until the following moult. Then in proportion as the cuts approach the tarsus, contraction becomes less and less evident, until in the neighbourhood of the tibio-tarsal articulation the divided muscles practically remain in position; so that the part in process of regeneration may be visible before a moult takes place. The result is the same when the cuts are made on any of the first three joints of the tarsus.

On examining the internal structure of the limb we find that it is precisely in the spot under discussion—upon the lower portion of the tibia and the first joints of the tarsus—that the muscles are inserted which move the tarsus as a whole and its various parts. Cuts made in this region pass through the surfaces of the chitinous covering to which these muscles are attached and from which they run towards the joints below which they have to move. Under these circumstances one can understand why the contraction will be slight or not produced at all. It is only possible to produce it when the cut is more or less remote from the upper attachment-surface of the divided muscles, which is not the case. In other insects there is complete withdrawal of the cut muscles when the section passes through the tarsal region. It is evident that these particular features point to differences in the number and position of the attachment-surfaces of the muscles in question, differences which are revealed upon careful dissection.

It follows, then, that among the Phasmidæ parts in process of regeneration in the region we are considering are more or

less apparent from the outset of their formation. As I have already said, however, growth proceeds with the greatest slowness; it follows therefore that during the time which elapses before the next moult the part in process of growth barely forms a minute projection from 1 to 2 millim. in length. It is covered by a thin protective cuticle of a brown colour, moulding itself exactly upon the rudiment of the limb, which up to the present shows no separation into joints. It is only after the next moult that the limb, beginning to be of appreciable length, will show any distinct traces of division into tarsal joints. The growth is so slow that it is only after two or even three moults that the mutilated limb is completed and becomes serviceable to the insect *.

It is interesting to compare the slowness of the growth of parts in process of regeneration after artificial removal, as well as that—much less marked nevertheless—of limbs intended to replace those removed by self-mutilation, among Phasmidæ with the marvellous rapidity of such growth which has been found among the Mantidæ and Blattidæ. Whilst among the latter limbs regenerated after self- or artificial mutilation may begin to be of use to the insect immediately after the next moult, in the Phasmidæ limbs in course of regeneration cannot become useful until after the second or third moult. I have noted that the same holds good for the Orthoptera saltatoria.

LXVII.—*New Species of the Coleopterous Genus* Prionocalus *from Ecuador and Peru.* By Chas. O. Waterhouse, V.P.E.S.

The British Museum has recently received a few specimens of Longicorns of the genus *Prionocalus*. One I refer with a slight doubt to *P. cacicus*, White, but in the type the tubercle

* In the most perfectly regenerated limbs there is a tetramerous tarsus. I have nevertheless obtained after cuts made upon the third joint of the tarsus:—

1. A pentamerous tarsus with incompletely separated joints.
2. A pentamerous tarsus as perfect as the normal one.
3. A bent and monstrous tarsus of six incompletely separated joints.

But these are rare exceptions to the rule. Tetramery after regeneration has been determined among the Phasmidæ not only in the four genera I quoted in my previous papers, but also in *Anchiale, Acanthoderus, Lopaphus, Diapheromera,* and probably in *Cyphocrania, Diura,* and *Bacteria mexicana*, the total number of species of Orthoptera cursoria in which tetramery has been determined being thus twenty-five.